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Hopewell Archeology: Volume 7, Number 1, December 2006

Mark J. Lynott

National Park Service, mark_lynott@nps.gov

Ann Bauermeister

National Park Service, ann-bauermeister@nps.gov

Christel M. Baldia

National Park Service

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Hopewell Archeology:

The Newsletter of Hopewell Archeology in the Ohio River Valley
Volume 7, Number 1, December 2006

1. Excavation of the East Embankment Wall, Hopewell Mound Group: A Preliminary Report

By Mark J. Lynott

There are many famous and well known earthen enclosure sites in southern Ohio, but none has greater name recognition than the Hopewell site itself. With at least 40 mounds, the site is impressive enough, but the presence of more than 4 km of earth and stone embankment walls forming one large enclosure and several smaller ones makes this site clearly worthy of being the type site for this famous epoch in the archaeological record. The site has been greatly modified by nearly two hundred years of cultivation and three major archaeological excavations, but much of the site still has the potential for productive research. This paper summarizes a recent excavation aimed at recording the materials and construction methods of the eastern wall of the main enclosure. Although the embankment walls at the Hopewell Mound Group have fascinated archaeologists for nearly two centuries, this is only the second attempt to document the nature of the earthen wall and ditch.

The first description of the Hopewell Mound Group was provided by Caleb Atwater (1820), who estimated the area within the large enclosure at 110 acres. Atwater observed that it is "generally twelve feet from the bottom to the summit of the wall, which is of earth. The ditch is about twenty feet wide, and the base of the wall the same. There is no ditch on the side next the river. The small work, on the east side, contains sixteen acres, and the walls are like those of the larger work, but there is no ditch. The largest circular work, which consists of a wall and ditch like those already described, is a sacred enclosure, including within it six mounds, which have been used as cemeteries" (Atwater 1820: 183).

Squier and Davis (1848) described the main enclosure as a parallelogram, 2800 feet by 1800 feet with one rounded corner. They note that the wall along the creek follows the edge of the bank, and contains a lot of water rounded cobbles. The wall along the creek was 4 ft. high in 1846. The north and east walls are 6 feet high and 35 ft. wide at base with an exterior ditch of similar dimensions.

W.K. Moorehead (1922) conducted excavations at the Hopewell Mound Group in 1891 and 1892 for the World's Columbian Exposition and produced some of the earliest photographs of the site, including this image (**Figure 1**) of the field camp adjacent to the embankment wall and ditch. Moorehead's report was not published until 1922, and his published map and description of the mound group rely heavily on the description provided by Squier and Davis (1848).

H.C. Shetrone conducted additional excavations for the Ohio Archaeological and Historical Society from 1922 through 1925. Shetrone described changes in the site since Moorehead's research, and also discrepancies between what he observed and what previous researchers had reported. Shetrone took note that at the Turner Works near Cincinnati, F.W. Putnam found burials and other features had been incorporated into and under the earthen embankment walls. In addition to excavating mounds, Shetrone conducted exploratory excavations in the walls at the Hopewell Mound Group to determine if similar materials might be present.

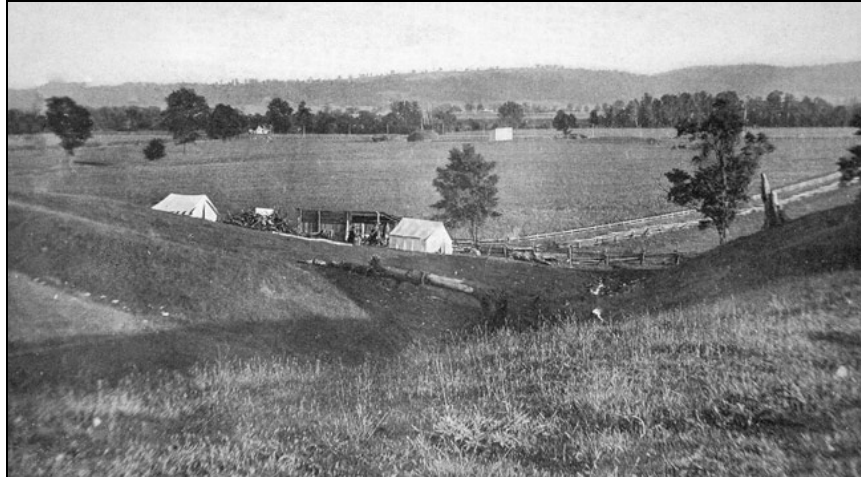


Figure 1. View of Moorehead's field camp and the main embankment wall and ditch in 1891 or 1892. (Moorehead 1922, plate 38)

Shetrone excavated 200 ft. of the east wall of the main enclosure. He reported that "Upon the original surface were found several unimportant and not well defined fire-beds, which apparently were only incidental to occupation previous to the erection of the wall. Tests at other points revealed nothing" (Shetrone 1926: 112).

After nearly two centuries of cultivation, only the walls of the main enclosure are still visible. Fortunately, geophysical survey has proven to be an effective tool for relocating and mapping earthen walls in this region (Lynott and Weymouth 2002). In 2004, Arlo McKee (2005) conducted a detailed geophysical survey of the area surrounding Mound #23 and the main embankment wall east of Mound #23. McKee surveyed an area 120 m by 60 m with a G858 cesium magnetometer, EM-38 conductivity meter, and RM-15 resistance meter. His data show that although Mound #23 had been thoroughly excavated, the floor at the base of the mound is readily visible (**Figure 2**). The geophysical data also clearly shows the embankment wall and associated ditch. His study is one of several recent studies of Hopewell earthen enclosure sites in the Scioto Valley which demonstrate that geophysical survey can be an effective tool for relocating earthen architectural features.

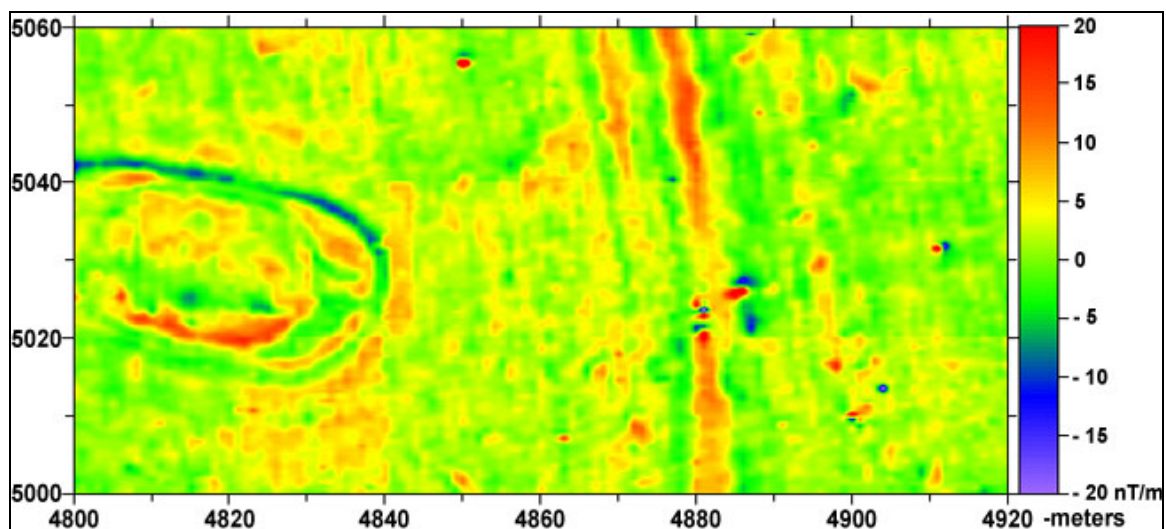


Figure 2. Magnetic map of area surrounding Mound 23 from McKee 2005.

In June 2006, the Midwest Archeological Center excavated a trench across the eastern embankment wall of the main enclosure. The location for the trench was selected after reviewing the geophysical data collected by McKee in 2004. This data indicated that at least part of the earthen wall was intact in this area. An east-west transect across the embankment wall, which runs roughly north-south at this location, was chosen. With assistance from Jennifer Pederson and Kathy Brady-Rawlins, wooden stakes were set to identify the corners for a trench that was potentially 60 m long and 2 m wide.

The width of the trench was excavated as planned, but the length of the trench was reduced to focus our efforts on what remains of the embankment wall and exterior ditch. Consequently, the trench that was actually excavated was 44 m long and 2 m wide. Excavations were done largely with a backhoe (**Figure 3**). Several small areas of charcoal or discolored soil were identified and left in place for hand excavation (**Figure 4**). Most of these were later determined to be products of bioturbation, and the two that were probably cultural features do not appear to be related to wall construction activities. One post hole in the wall fill was observed and recorded but it appears to predate the deposition of soils that were used to form the embankment wall.

The north wall of the trench was used to record the soil layers present in the trench, and clearly shows that all of the A horizon and likely much of the B horizon were removed from this area prior to the start of wall construction (**Figure 5**). This practice would appear to be fairly common in the construction of earthen enclosures in the Scioto River valley, and is well documented from our work at the Hopeton Earthworks (Lynott et al. 2005).



Figure 3. Backhoe excavation of Trench 06-1, June 2006 (photo by Jeanna Boyett).



Figure 4. Hand excavation of Trench 06-1, June 2006.



Figure 5. North wall of Trench 06-1 showing basal remnant of the East Embankment wall.

Unfortunately, agricultural activities have severely truncated the wall, so the observations presented here are based totally on the basal remnants of the earthen wall. The primary intact material forming the core of the wall is a yellow-brown loam. This rests on the truncated subsoil and itself has been truncated at the top by plowing. Consequently, it is impossible to determine if this formed the bulk of the wall fill or just the foundation. At the western end of the wall fill, there is a small area of intact wall fill that is comprised of red-brown silt loam with lots of gravel. This layer is quite distinct from the yellow brown wall fill, and the sharp boundary between the two is consistent with the methods of construction that have been recorded in other Scioto River valley embankment walls. We cannot determine if this small remnant of red soil once formed a larger deposit that covered the interior of the embankment wall surface, but this would be consistent with construction approaches at other earthen enclosures in this region.

The western margin of the wall is visible at E4863 as an organic dark gray loam with gravel that is probably a soil that formed on the wall surface and was subsequently covered by wall fill after cultivation was initiated in the nineteenth century. This soil layer rises from west to east and is truncated by the plowzone. A corresponding layer on the eastern side of the wall would have merged with the exterior ditch at about E4874, but evidence of it has been destroyed by cultivation.

The exterior ditch is visible from about E4873.5 to E4878.5. The ditch was excavated down into the loose sand and gravel subsoil on the exterior or east side of the embankment wall (**Figure 6**). The close proximity to the embankment wall indicates they were likely built at the same time. The sand and gravel subsoil into which the ditch excavated is very loose and unconsolidated. To prevent this material from slumping into the ditch, the builders of this feature lined the ditch surface with a brown clay loam. This was a very tight and stable surface. A dark organic gray loam with charcoal was found on top of the ditch lining. This is a re-deposited layer that likely formed from materials that washed into the ditch after the wall and ditch were built. Soil materials in the ditch above this layer are also re-deposited, possibly after the start of cultivation in the nineteenth century.



Figure 6. North wall of Trench 06-1 showing Rolfe Mandel and Arlo McKee examining the external ditch in profile.

The great earthen walls that form the enclosures at the Hopewell Mound Group have attracted scientific attention for nearly two hundred years. In 1925, H.C. Shetrone of the Ohio Archaeological and Historical Society excavated 200 feet of the eastern wall of the main enclosure. Shetrone had hoped to discover burials and other features within the fill of the wall. Although he did find features under the earthen wall, they were uninteresting in comparison to the mortuary features he unearthed under the mounds. Shetrone devoted only a few lines in his 1926 report to this wall excavation, and observes that the wall was built with fill from the adjacent ditch.

Years of cultivation have reduced most of the embankment walls at the Hopewell Mound Group to the point where they are barely discernable. Geophysical evidence suggested that at least the base of the wall was preserved in the area near Mound #23, and the test trench excavated in 2006 demonstrated that this is indeed the case. Unfortunately, only the very bottom of the original wall remains undisturbed, but this enough to provide us with some insights into how this portion of the wall was constructed.

The absence of an A horizon under the wall suggests that the top soil from this area was removed before the wall was built (**Figure 7**). It would seem likely that much of this topsoil was quarried and used in construction of the many mounds at this site. Whether topsoil was quarried across the entire surface of the site is unknown at this time, but it would seem likely that exposing the subsoil was part of the architectural ritual.

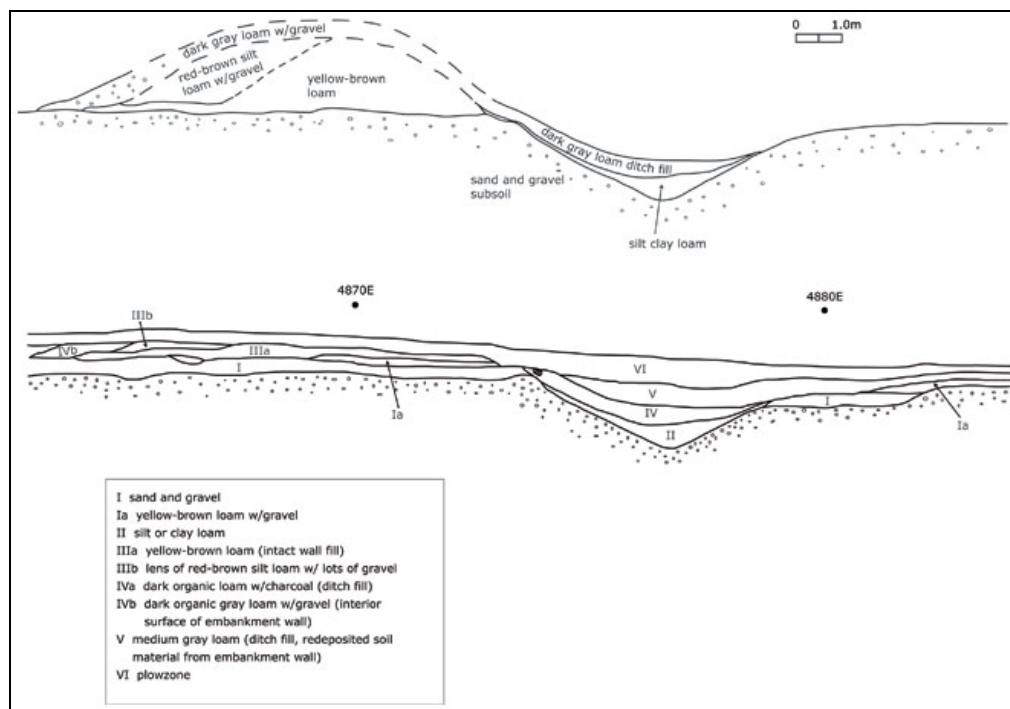


Figure 7. Drawing of north wall of Trench 06-1, and hypothetical reconstruction of original wall strata.

The wall remnant is comprised of two different soils. A yellow-brown loam and a red-brown silt loam with lots of gravel. These two soils do not appear to have been randomly piled together to form the wall, but were kept separate and unmixed. The fill at the base of the mound is definitely not the sand and gravel subsoil material that was quarried from the

adjacent ditch. The red-brown silt loam is not present near the ditch and must have been quarried somewhere else nearby. The ditch was dug into loose and unconsolidated sand and gravel subsoil, and the builders lined the ditch with a clay loam to stabilize it. The clay loam also had to have been quarried from somewhere else and brought to this location.

The clay lined ditch is very similar to the ditch recorded by Frank Cowan at the Shriver Circle near Mound City Group (Cowan, Picklesimer and Burks 2006). Cowan believes the clay lining at Shriver was intended to hold water in the ditch, and this may also be the case at the Hopewell site. While analysis is ongoing, the rich soil that formed in the bottom of the ditch may reflect a moist environment. Squier and Davis (1848) speculated that the builders of the earthen walls may have re-directed the flow a stream channel to flow in the ditch of the west wall of the main enclosure. Small springs were present at the base of the hill on the north side of the main enclosure in 1848, and one of these may have been directed to flow in the ditch along the east wall of the main enclosure.

Hopewell earthen enclosures in southern Ohio exhibit many different shapes and the walls vary in size and configuration. Early scholars assumed that walls which were built in association with ditches were built from soil quarried from the ditch. This was likely the case at some sites, but not at the Hopewell Mound Group. While it is likely that the ditch fill was used to build parts of the wall, materials used in the walls appear to have been carefully sorted and not mixed together.

The absence of any dateable features associated with wall construction makes it impossible to determine the absolute age of the embankment wall and ditch. However, it is notable that the removal of the A horizon preceded wall construction at least in the area around Mound #23. If this observation holds true for the entire embankment wall, it is likely that the missing A horizon was used in construction of some or all of the mounds at this site. If that is the case, then the embankment wall and ditch were likely built after mound building was well established at this site. Further research on the embankment walls is clearly needed to determine if the evidence recorded in our 2006 trench is typical of the rest of the site.

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Hopewell Archeology:

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2. Archeological Data Recovery Field Investigations at Site 33RO1059

By Ann Bauermeister

In June and July 2006, a team from the Midwest Archeological Center conducted field investigations for an archeological data recovery project at site 33RO1059. They were assisted by Hopewell Culture National Historical Park (HOCU) personnel and by students from Nebraska, Virginia, Ohio, and Illinois, who participated in the project as part of the University of Nebraska's archeological field school, directed by Dr. Mark Lynott. Additional expertise was provided to the project by Dr. John Weymouth, Dr. Rinita Dalan, Bruce Bevin, and Dr. Rolfe Mondell; respectively, they conducted gradiometer survey oversight and data analysis; a magnetic soil susceptibility study; additional geophysical survey; and a geomorphological study.

Site 33RO1059 is non-earthwork Hopewell site that is located adjacent to the extensive earthwork complex—the Hopewell site (33RO27). Part of HOCU's Hopewell Mound Group unit, site 33RO1059 is situated in a formerly cultivated field on an alluvial terrace overlooking the North Fork of Paint Creek to the south. The project was initiated because archeological resources were being threatened by the erosion occurring along the southern edge of the field and the National Park Service determined it was necessary to protect the site from additional damage. Site management alternatives included mitigation of impacts through mechanical stabilization or excavation. The latter was chosen because it would prevent the loss of site resources through data collection, but would not require the extensive amount of ground disturbance necessary for the construction alternative or impact natural stream dynamics.

Previous investigations at 33RO1059 were undertaken in 2003 and 2004 and included geophysical survey, surface collection, and evaluative testing based on results from the geophysical survey (DeVore and Bauermeister 2003; Bauermeister 2004; Burkes 2004). The archeological materials identified during those investigations led to the conclusion that the site may have been occupied when the nearby earthwork complex was in use and thus may contain important information about Hopewell settlement patterns adjacent to the earthworks. The implementation of the data recovery project provided archeologists an excellent opportunity to address specific research questions about this site, including:

- 1) What type of Hopewell settlement is represented at site 33RO1059?
- 2) Is there chronological control in the archeological record that indicates contemporary use with the Hopewell site, and if so, is there evidence of seasonality that indicates what time of year the earthworks may have been used?
- 3) What is the relationship between site 33RO1059 and other nearby non-earthwork sites with Middle Woodland components?

The 2006 investigations targeted four 20-x-20-meter block areas within the defined mitigation area, a 38-meter wide corridor along the stream bank that includes the projected extent of erosion and a buffer zone, for archeological excavation. Three of the blocks were identified, through surface collection and geophysical survey, as having good potential to contain

additional archeological resources while the fourth block was located where resources were not expected, thereby serving as a test for how survey results were interpreted. Block 1 was situated in the southwest section of the field where the majority of previously identified Hopewell artifacts and features were recorded. Block 2 served as the test block; it was located in the southeast section of the field. Blocks 3 and 4 were contiguous west to east and were placed approximately midfield toward what would be the northern boundary of the mitigation area. These two blocks straddled a linear ridge that bisects the site along a southwest to northeast diagonal. This landform is natural in origin and interpreted as a point bar created from ancient river movement.



Figure 1. Test unit excavations within Block 1.

To start, the plow zone from each block was removed using a backhoe and the floors were skim shoveled by hand to reveal any soil stains or potential cultural features. Next, the blocks were resurveyed with a FM36 fluxgate gradiometer, using the same technique and methodology applied to the area in 2003. Select areas within the blocks were then subject to additional geophysical surveys by Dr. Dalan and Bruce Bevin. This strategy is providing archeologists a unique opportunity to compare geophysical data from the same area both with and without the plow zone stratum. A total of 41 suspected features were identified through visual inspection of the 4 blocks. Individual test units were placed over each of potential features and nine additional test units were placed where anomalies appeared in the geophysical data, but were not exposed in the floor (**Figure 1**). As a result of the excavations, 13 features were determined to be cultural in nature, with eight of those located in Block 1 (**Figure 2**), four in Block 3, and one in Block 4.

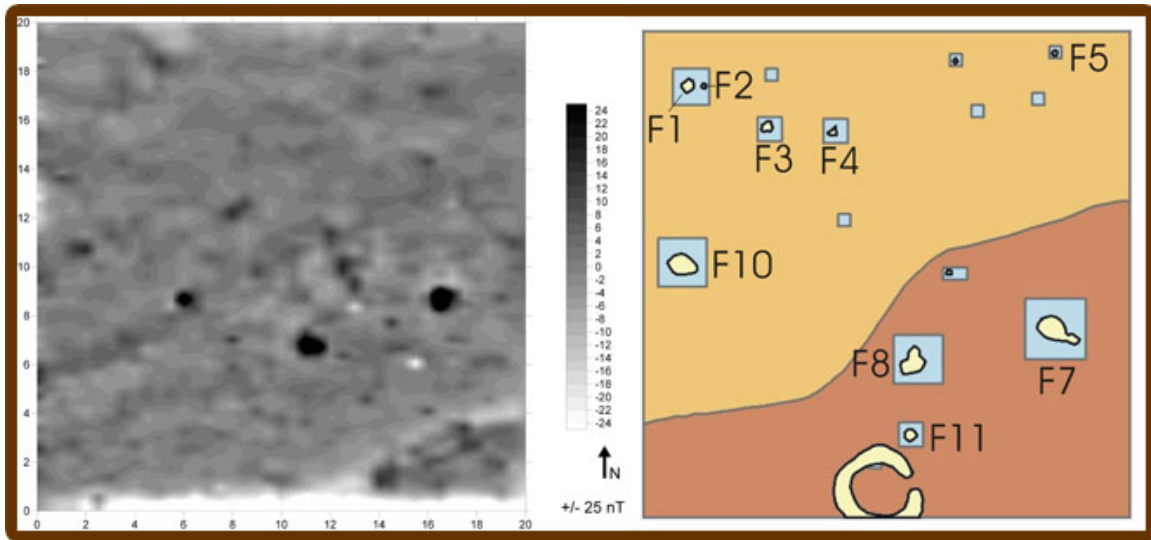


Figure 2. LEFT. Geophysical survey data from Block 1; the magnetic anomalies (black) were interpreted as probable prehistoric cultural features. RIGHT. Plan map showing the location of verified prehistoric cultural features in Block 1.

Block 1 Features 1, 3, 4, and 5 are similar in that they are circular in plan, have a fill comprised of dark brown loam and charcoal, and contain few, if any, artifacts. They are thought to be post holes, though there is no obvious patterning to their placement. Block 1 Features 10 and 11 are both oval pit features; Feature 10 yielded numerous artifacts including fire-cracked rock, debitage, pottery, and a bladelet while a single pottery fragment was all that was recovered from Feature 10.

Block 1 Features 7 and 8 are large, well-defined, circular pit features that exhibited evidence of burning and produced a substantial amount of cultural material, including numerous diagnostic Hopewell artifacts (**Figures 3-4**). The contemporaneity of the filling of these two features was confirmed when several pottery sherds recovered from the two features were cross-mended. At least six vessels are represented in the combined pottery assemblage ($n=429$) and three of those have tetrapodal bases (**Figure 5**). Fourteen bladelets, fire-cracked rock, charcoal, six bone tools, calcined bone, debitage, mica, and a pitted stone, were among the materials collected from the two features.



Figure 3. LEFT. Block 1 Feature 7 being excavated. Figure 4. RIGHT Cross-section of Block 1 Feature 8.



Figure 3. Base of tetrapodal pottery vessel found in Block 1 Feature 8.

Block 3 Features 2 and 4 and Block 4 Feature 10 are classified as possible post molds given their circular shape and dark loam fill; none yielded any artifacts. Block 3 Features 1 and 5 were small pits demarcated from the surrounding rocky soils by their fill of dark brown loam and charcoal. Feature 1 produced a bladelet and several pieces of unconsolidated fire-cracked rock.

Analysis of materials from site 33RO1059 is ongoing and the preliminary results are promising for being able to answer the research questions set forth. The Block 1 Feature 7-8 assemblage provides the best evidence for a Middle Woodland period Hopewell occupation. This unique assemblage that includes tetrapodal pots, bone tools, mica, and bladelets, suggests specialized activities were taking place at this location. In addition to the artifacts identified and collected during the field investigations, a 100% sample of feature fill was collected for flotation and further processing that will hopefully provide information about seasonality at the site. This processing, along with laboratory analysis of the bone, macro-botanical remains, lithics, and pottery are underway and radiocarbon dates from are pending. The Midwest Archeological Center will prepare a report on these findings to be completed in 2007.

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Hopewell Archeology:

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3. Development of a Protocol to Detect and Classify Colorants in Archaeological Textiles and its Application to Selected Prehistoric Textiles from Seip Mound in Ohio. PhD Dissertation, The Ohio State University, Columbus Ohio, 2005

By Christel M. Baldia

The goal of this dissertation research was the development of a protocol to study colorants applied to archaeological perishable materials such as textiles even if these colors are no longer visible to the unaided eye. The protocol is composed of a sequence of non-destructive or minimally destructive methods designed to yield a classification of the colorants that were used prehistorically as inorganic or organic and pigment or dye. This protocol was then applied to selected textiles from Hopewellian Seip Mound Group in southern Ohio to test its effectiveness on actual artifacts.

The protocol consists of a succession of analytical methods that have been adapted to be used with very small sample sizes. If these are sequenced properly, the efficacy of the protocol is further optimized, thereby maximizing the acquisition of critical data while minimizing the need for large amounts of sampling material, and thus preserving the integrity of the artifacts.

The methods used were forensic photography using different lighting conditions (simulated daylight, infrared and ultraviolet), optical and scanning electron microscopy with energy dispersive X-ray analysis (EDS), and inductively coupled plasma mass spectrometry (ICP-MS) for elemental analysis. All methods were first tested on replicated materials thereby establishing suitable parameters for their application to archaeological textiles. During the course of working with the replicas, limitations of the analytical methods were discovered and addressed for their use on archaeological materials, i.e. a limited quantity of material with an unknown chemical composition. These materials have potentially undergone degradation processes and could have been exposed to a variety of contaminants, which all must be considered during the analysis. For example, the digestion of the sampled material for the ICP was refined and a more appropriate instrument was selected based on the results of working with the replicas.

To reach the goal of using a minimal amount of sampling material, it is essential that the series of steps within the protocol are performed in the suggested sequence. One step builds on the previous one with several key tasks that must be performed before continuing with the analysis.

First, a comprehensive and systematic visual examination of the textile fragments (obverse and reverse side) must be conducted. Much can be learned if this is done meticulously. For instance, many details that had not been expected were discovered when the textiles were turned to the reverse side. The lighting conditions must be controlled for this process to guarantee reproducibility. Otherwise, the results will differ as the lighting temperature differs.

Then suitable textiles that represent types within an assemblage based on the results of the visual examination are selected. For instance, the Hopewell textiles were grouped by commonalities in color and physical condition such as charring. Magnification should be used if necessary so no details are overlooked while also controlling the lighting.

Next, non-destructive forensic photography is used as a precursor to all the other steps. Before any other analytical method can be employed, the photography of the textiles in different lighting conditions must be performed because it reveals different chemical signatures due to colorant/substrate interaction even if these are no longer visible. This optical behavior is used to discriminate areas of diverse chemistry that can be correlated to colorant application or contamination. Thereby, the photography facilitates selective sampling of these areas, while areas of like chemistry do not need to be sampled. Thus, purposive sampling enables focused stratified sampling, increasing the opportunities for critical data acquisition while decreasing the need for the copious sampling of the material.

At this point, particulate matter should be collected. This dust-like particulate matter could consist of small textile fiber fragments and contaminants, which gives the first indication to the researcher about the textiles' state of degradation. The more particulate matter there is, the more likely the textiles are severely fragile due to degradation or mineralization. Furthermore, the particulate can give detailed information about the textile as a whole, and it can be used for optical microscopy and possibly other analyses that pertain to the continuous textile such as infrared spectroscopy.

After that, a detailed macroscopic examination, which also should be done in controlled lighting conditions, must be performed. Information about the physical state of the fibers can be gained. For instance, some of the Seip textiles showed many fractured and fragments of fibers within a yarn structure that still appeared to be intact, therefore making it very fragile. Furthermore, the colorant penetration and levelness of color can be determined, and adhering particulate can be observed.

This should be followed by the sub-sectioning the samples to divide the materials for further analysis. Subsequently, optical microscopy (OM) of the sub-samples can be performed to reveal fiber morphology and optical behavior. Additionally, the particulate that was collected earlier should be studied. This process should not be hurried since it takes some time to get accustomed to the samples and to recognize what is important in these samples. Images of these micrographs should be collected, and if a digital camera is used, the colors that are seen on the screen should be calibrated and matched to the colors seen in the microscope.

Next, scanning electron microscopy (SEM) on the sub-samples should be performed. One of the strengths of SEM is the ability to capture detailed surface morphology that may not otherwise be detected. Furthermore, the great magnification that can be achieved with SEM shows details such as degraded scales from hair fibers or even the medulla cells that otherwise cannot be detected by optical microscopy.

While collecting images with the SEM, energy dispersive x-ray analysis (EDS) of the fibers and all their components, i.e. fibers and particulate adhering to them should also be performed. The EDS only gives the relative ratio of elemental composition of fibers and adhering materials, which cannot replace quantitative analysis. However, EDS is a good qualitative method to detect elemental composition. EDS constitutes a key step that allows the evaluation of carbon compared to the zero baseline, hence indicating the presence or absence of organic compounds such as dyes. If organic components are present, organic analysis methods should follow as the next step, while the inorganic path of analysis should be taken if inorganic constituents are present. Furthermore, the relative ratios of elements detected by EDS in different areas of one fiber can be compared to each other, to other fibers or to the elemental content of the particulate adhering to the fibers. Thereby, EDS can give information about ratio of organic and heavy elements, presence of mineral based colorants, the degree and variability of fiber mineralization, and possible contaminants.

For the inorganic path of analysis, such methods as ICP-MS/OES or LA-ICP-MS can be used. For these analyses, the potential problems that may occur during the digestion process that prepares spectrometry samples to be analyzed with various potentially suitable instruments were explored. When dealing with archaeological textile materials, it must be assumed that the samples will not digest well and that sample size is very small; and therefore, appropriate adjustments must be made. Knowing the relative ratio of elements present in the samples from results of the EDS will ease this process greatly, because appropriate replicas can be created, and the most likely successful digestion agent can be chosen to perform the spectrometry. For the organic path of analysis, such methods as gas or liquid chromatography followed by mass spectrometry, micro-infrared (IR) and Raman spectroscopy must be explored. It must be assumed that problems similar to those found when preparing the samples for ICP-MS will also be found when other methods such as chromatography are used. Therefore, a successful trial run of every analytical method with replicated materials must be conducted before using artifacts. Thereby, subsequent analyses of the artifact material are most likely to be successful without having to be repeated; thereby the amount of sample material that is needed will be kept at the absolute minimum.

Based on an initial visual examination, eleven Seip textiles were selected and divided into three main color groups: (1) yellow/brown, (2) turquoise/white, and (3) charred. These are representative of textiles from the actual assemblage. An extensive, painstaking visual examination under controlled light and description of the selected textiles' obverse and reverse sides was conducted. Then both sides of the selected textiles were photographed in UV, warm and cool visible, and IR lighting. Based on the findings of the forensic photography, purposive sampling of the artifacts was conducted. Although the sample sizes were small, they were representative of the studied textile assemblage. The yellow/brown textiles showed some encrustations on the fiber surfaces and severe fragmentation of the fibers. The fabrics were constructed of rabbit hair with colorant saturated fibers, which indicates that dyes were used as colorant sources. There were some surface deposits, but these could not be linked to the colors of the fibers. Many of the colored fibers showed no deposits at all.

The elemental composition of the materials from the three colors in this group did not show any differences between the colors. All colors contained a large amount of copper, some iron and small amounts of soil minerals, but they also contained large amounts of carbon, and some sulfur indicating organic materials in the fibers. It was concluded that the organic constituents of the fibers had been partially replaced by copper in a mineralization process. While these textiles were not reported to have been in contact with copper, they must have been saturated by copper corrosion products carried by ground water, i.e. they were near copper albeit not directly adjacent to it. The encrustations that were observed in the optical microscopy and the severe brittleness of the fibers support this statement.

The textiles belonging to the turquoise/white group were made of milkweed fibers that were painted with different pigments. These colorants had not penetrated into the fibers, but adhered to the fiber surface. Different lighting conditions during the photography showed various dissimilar aspects of the patterns, indicating differences in chemical signatures, and thereby different colorants that had been applied. The elemental analysis indicated large amounts of copper, and small amounts of other elements. It was concluded that the white color was likely kaolin and that some of the other colors had been mixed with the kaolin or some other types of clay. These textiles were relatively stable when comparing them to the state of degradation of those from the two other groups.

The charred textiles were extremely fragile. Patterns no longer visible in fluorescent white light were visible using photography, and the simulated daylight showed them best. Ovate

motifs in blue, ochre color and different shades of grey were found. When magnified, it could not be determined if the colored fibers were penetrated by dyes, because they are too charred to transmit light. However, different inorganic particulates adhered to the outside of these colored fibers, and some of these deposits were iridescent. Large amounts of iron were found in these colored fibers, but also some copper. The orange/red substance without any fiber material showed the same spectra as did the fiber but with lesser carbon peak, thereby verifying that the fibers still contain some amount of organic material. Fibers without any colorant on them had less iron and higher carbon and calcium peaks.

Two textiles were identified as composite upon examination. Both consisted of a combination of several layers of materials: fabric, leather and matting. Due to the complicated nature of these specimens, they were only described but could not be addressed otherwise.

Considerations for Further Research

All research seems to create as many questions as it provides answers, and with that it provides room for more work. This research is no exception. Based on the findings of this study, these are some suggestions for further work.

1. For the digestion process to prepare samples for spectrometry, ultrasound needs to be applied to the nitric acid/sample mixture to achieve better digestion.
2. Different potential digestion solutions or a combination of these such as hydrochloric acid (HCL) and hydrofluoric acid (HF) should be explored. Since these can cause problems such as the matrix effect, they must be tested with replicated materials.
3. The phytochemistry of many plants that were used by Native Americans has not been analyzed yet. Colorant constituents must be identified in such genera that are known to yield dyes such as the native *Indigofera* species.
4. Standards of North American dye plants and their colorants must be created for potentially applicable methods such as Infrared and Raman spectra.
5. The methods to detect organic dye constituents such as micro-Raman, micro-IR, GC-MS need to be explored, tested with replicated materials and then applied to actual artifacts.
6. The compositional data reported herein should be explored as to which inorganic pigments could have rendered the color to the textiles.
7. Quantitative elemental analysis should be conducted to link the colorants from the textiles to potential color producing minerals.
8. Composite images from the pictures that were taken should be created, thereby creating a likeness of what the textile might have looked like in the past, but also to potentially differentiate and sequence tasks in the production process.
9. The research done by Song and Thompson on the structures of the Seip textiles should be correlated with the chemical analysis and microscopy from this research.
10. Trace element analysis of copper artifacts should be done and compared to the copper content of the textiles.
11. With the discovery of a bast fiber that had not been identified before, new aspects of Seip material culture came to light. This bast needs to be identified.
12. The two textiles that were identified as composite herein need to be studied in a separate project.
13. The insect piece that was found should be identified, and further research should consider when insect infestation of the textile occurred.

The dissertation will be available in full length to the public through Ohio Link in 8/02: Click [here](#) for dissertation.

In the mean time, please refer to:

Baldia, Christel M. and Kathryn A. Jakes

2006 *Photographic Methods to Detect Colorants in Archaeological Textile*. Journal of Archaeological Sciences; in press.

2006 *Toward the Classification of Colorants in Archaeological Textiles in Eastern North America*. In: Archaeological Chemistry: Analytical Techniques and Archaeological Interpretation, American Chemical Society Monograph Series; in press.

Baldia, Christel M, Kathryn A. Jakes and Maximilian O. Baldia

2006 *Polychrome Hopewell Textiles: Dye Technology at Seip Mound in Southern Ohio* In Proceedings Textile History Forum, Meeting on October 6-7th at the Museum in Winterthur DE.

In preparation:

Social Implications of the Colorant Application Technology to Textiles from the Hopewellian Seip Mound Site. American Antiquity.

Small Things in Big places: Textiles and Colors from the Seip Burial Mound Group in Ohio. In Acts of the XVth UISPP Congress, University of Lisbon, Portugal, 4-10 September 2006. BAR International Series, Oxford, England.

Hopewell Archeology:

The Newsletter of Hopewell Archeology in the Ohio River Valley
Volume 7, Number 1, December 2006

4. The Great Hopewell Road: GIS Solutions Towards Pathway Discovery

By Timothy A. Price

Traversing hills, valleys, and streams, the sixty-mile long Great Hopewell Road might have begun at the monumental earthworks located in Newark, Ohio and ended near Chillicothe, at the site of another ancient earthwork named the High Bank Works. It is tempting to try to connect these two earthworks for they both contain circular and octagonal arrangements, aligned in ways that suggest that one of the complexes might have been built to complement the other, perhaps through a unifying religious ritual that followed the 18.6-year lunar cycle (Aveni 2000:226, Lepper 1995). More important, the Scioto Valley was the “undisputed center of Ohio Hopewell culture” (Lepper 2002), so a road passing through the region could have linked the area together.

Monumental roads were not uncommon in prehistoric North and Central America. Aveni (2000) and Nials et al, (1987) examine how other studies have shown prehistoric cultures engaged in very similar road-building phenomena. In the Yucatan, for example, Mayan roads connecting various ceremonial and sacred sites are well known. Similarly, the Anasazi of the southwestern United States constructed sacred roads and pathways between their most important places of pilgrimage. The same can be said of numerous places in Europe, India, and China.

The Hopewell Indians, who flourished in central and Southern Ohio between approximately 200 B.C. and A.D. 500, appear to have been no different from their counterparts. A deeply religious group, the Hopewell were “wide ranging in their contacts, with a resource network that reached for hundreds of miles in all directions” (Romain 2000:2). Still though, much of the direct confirmation for the existence of such a colossal achievement comes in the form of early land surveys, aerial photographs, and, for some, just a plain “gut” feeling about the road’s existence. Caleb Atwater, one of Ohio’s first archaeologists, suggested in 1820 that the parallel walls that ran southwest from Newark’s octagon might extend 30 miles or more.

One of the most important pieces of evidence, however, is the map that James and Charles Salisbury, early residents of Newark, drew in 1862 depicting the Newark Earthworks and the series of parallel walls appearing to connect the various enclosures there. This document was misplaced for decades following the Civil War, only to be rediscovered in 1991 at the American Antiquarian Society in Worcester, Massachusetts by Dr. Brad Lepper. The Salisbury’s traced these walls and, although they did not follow them to their end, they noted that:

“These works have been accurately surveyed and described – on account of the discovery of outside walls, connected with the fortified ways & other Earthworks of interest. One of the highways has been traced over six miles in the direction of Circleville. These walls are all of clay – differing materially from the soil on which they repose – which appears to indicate that originally they may have been constructed of adobe; or sun dried brick; similar to the fortified highways of the Incas of Peru” (Salisbury and Salisbury. 1862).

The Salisbury's map reinforces maps drawn by Squier and Davis in 1848, and Wyrick in 1866, while at the same time expanding on both works by giving details not previously mentioned.

Lepper, of the Ohio Historical Society, has recently searched along this same corridor between Newark and Chillicothe, Ohio for traces of road using aerial reconnaissance and archival photography, and has identified traces of parallel lineation along the projected route in several places. Lepper contends that the first segment can be found 16.2 miles south of Newark, while another is located at the projected terminus of the Great Hopewell Road near Chillicothe.

Using the locations that Dr. Lepper identified as a starting point; it is my contention that by using the tools of Geographic Information Science (GISc) we can begin to examine how the roles of slope, land cover, proximity to water, etc., would have played in the Hopewell's decision of where to locate just such a road

Methodology

Known places of prehistoric Indian activity were obtained from the Ohio Historical Society's database. Additionally, Dr. Lepper provided exact coordinates for the parallel lineation's which he had previously identified within the study area. Digital elevation and land cover data were acquired from the U.S. Geological Survey.

1. Once all of the data was collected, several assumptions about the Great Hopewell Road had to be decided upon so that modeling procedures could be implemented.
2. As is the case with modern roads, it likely would have been preferable to build the Hopewell road on relatively flat ground;
3. It was decided that certain land covers would have been better suited for road construction than others, taking into consideration the effort involved in moving across different land cover types;
4. The road would have been located near rivers and other water bodies

The road would have been located near the earthworks in Chillicothe and Newark since it is assumed that the road would have linked those locations, as well as near other ancient locations along the route.

Because so many variables were initially chosen for this study, it became necessary to assign a weighting scheme for the different datasets, and then produce a suitability model as the first step. This type of model allows researchers to find areas that are the most suitable for particular objectives.

To see if the possibility of a Hopewell Road was more fact than fiction, several cost-weighted distance/shortest distance models were created so that the shortest route could be identified without all of the variables initially included in the suitability model. Cost models identify optimum corridors and factor in economic, environmental, or other objectives. For these models, the dataset of the cost of traveling over the landscape was based on the fact that it is more costly to traverse steep slopes and construct a road on certain land types.

Discussion

While this study is not able to conclusively determine the existence of a Great Hopewell Road, it does set the stage for further research. In so doing, this study looked at several

variables that might have influenced the Hopewell's way of thinking when it came to deciding on just where to construct a road that stretched for 60 miles or more. This study examined proximity to water bodies, rivers, and other earthworks, as well as slope and land cover. When examined with all potential factors originally thought to be pertinent, the potential routes do not follow the projected route between Newark and Chillicothe. This, then, raises the natural question of which variables are essential to the calculations and which are likely extraneous.

Next, a model of the route was completed that looked solely at slope and land cover between the earthworks located in Newark and those found in Chillicothe. This possible route follows Lepper's predicted route extremely closely, deviating most on the southern portion. Moreover, this model shows two possible routes that the Road might have taken in the south. The only explanation that justifies this split is the fact that it occurs exactly where the Salt Creek River would cross the Hopewell Road.

For the final part of this study, the area between Newark and the southernmost point that Dr. Lepper believes to be part of the Road was examined. Again using slope and land cover as the main criteria, the shortest path between the two points was determined (**Figure 1**). In this model, the fit of the route again deviates from the projected path of the Hopewell Road only in the southern portion of the study area, but alters course to connect with Lepper's location. It is this model that most closely follows Lepper's predicted route of the Great Hopewell Road. Indeed, the majority of the model falls within a one-half-mile buffer zone of the projected road, while the entire model falls within two miles (**Figure 2**).

Figure 1

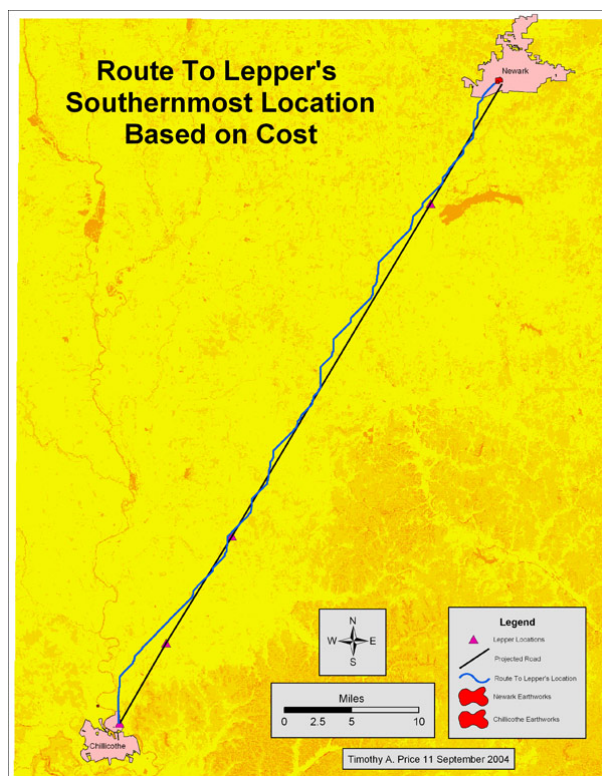
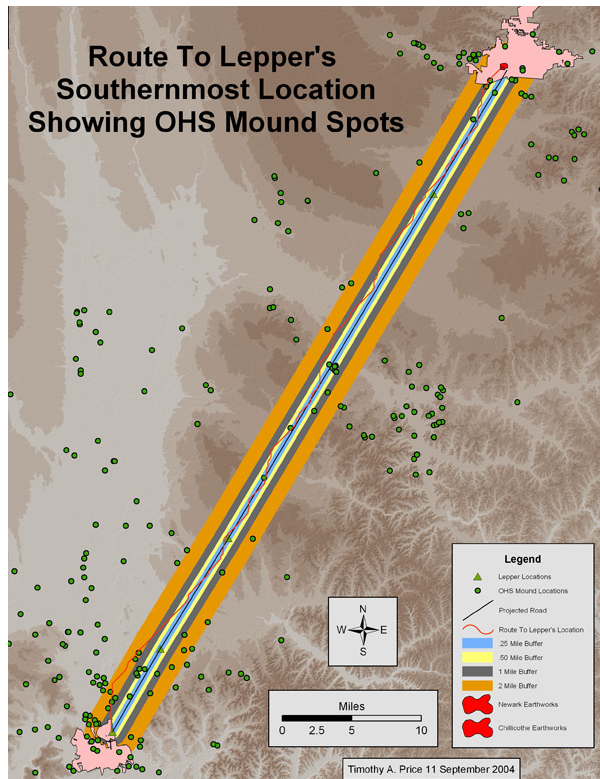


Figure 2



Results

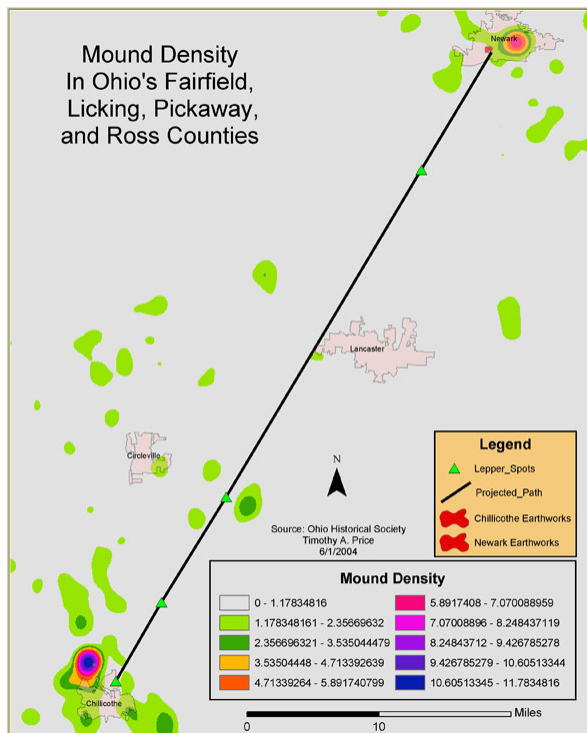
Slope and land cover appear to have made the most dramatic impact on the outcome of this study. It would appear that the physical landscape transpired with land use to reveal an astonishingly accurate connection between the two major archaeological sites located near Newark and Chillicothe, Ohio. Indeed, these considerations, as applied in the various models, appear to support Lepper's conclusion that the Hopewell "designed and laid out [the road] with great care and with intimate familiarity of the intervening landscape". The fact that the majority of the models that examined the area between Newark and Lepper's southernmost point fell within one half mile to one mile of the projected route is extremely significant; indeed, many portions follow the projected route almost exactly.

As a byproduct of this research, a second discovery was also revealed that is highly worthy of not only mention, but further investigation. Upon closer examination, the figure showing the Ohio Historical Society's ancient mound locations reveals a significant number of "events" that occur within the projected path's buffer zones. Out of 244 mound locations within the study area, fifty four fall within a two-mile buffer; 25 are within one mile, and twelve are within one half of a mile.

Looking at the mound density map, (**figure 3**), it becomes quickly apparent that the Ohio Valley was indeed a hotbed of prehistoric Indian activity. Perhaps the road was a means of connecting these various places, or, more likely, the

mounds were part of villages that sprang up along the way as it was being built. With the advances of radio-carbon dating in the field of archaeology, it might be possible to put a chronology to the sites located nearby that may help determine when the road may have been built and, possibly, in which direction the Hopewell might have started from. Only further investigations will allow researchers to find clues that may one day unravel these continuing mysteries.

Figure 3



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